

AMENDMENTS TO THE CLAIMS:

This listing of claims replaces all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

Claim 1 (currently amended): Apparatus for selectively receiving radio frequency (RF) signals, comprising:

an array of antenna elements for receiving the RF signals, said array including a center antenna and a group of antenna elements surrounding the center antenna;

a navigational controller for determining pointing vectors, each vector ~~corresponding pointing~~ to a respective source of a received RF signal, from coordinate information; and

beam-forming electronics connected to the array of antenna elements and the navigational controller for forming a reception lobe in the direction of each pointing vector, wherein a phase center for the array of antenna elements is maintained by adjusting the center antenna to a same phase shift for each of the reception lobes.

Claim 2 (original): The apparatus of claim 1, wherein the elements of the array comprise dual-frequency patch elements.

Claim 3 (original): The apparatus of claim 1, wherein the beam-forming electronics form the reception lobes by adjusting the phase of the elements of the array.

Claim 4 (original): The apparatus of claim 1, further comprising an antenna output from the beam-forming electronics.

Claim 5 (original): The apparatus of claim 1, wherein the elements of the array are arranged in a symmetric configuration.

Claim 6 (previously presented): The apparatus of claim 1, wherein the elements of the array are arranged in a radially symmetric configuration.

Claim 7 (original): The apparatus of claim 1, wherein the RF signals comprise signals from at least one global positioning system (GPS) satellite and the pointing vector comprises a satellite pointing vector.

Claim 8 (original): The apparatus of claim 1, wherein the reception lobes have a width of 25 degrees or less.

Claim 9 (original): The apparatus of claim 1, wherein said beam-forming electronics comprises:

at least one phase shifter connected to the array of antenna elements for shifting the phase of the received RF signal; and

a beam-forming algorithm processor connected to the at least one phase shifter and the navigational controller for calculating an amount by which the at least one phase shifter shifts the received RF signals in response to the pointing vector.

Claim 10 (original): The apparatus of claim 9, wherein the at least one phase shifter comprises an array of phase shifters.

Claim 11 (original): The apparatus of claim 10, wherein said beam-forming electronics comprises a means for summing outputs of each phase shifter of the array of phase shifters.

Claim 12 (previously presented): The apparatus of claim 11, further comprising an antenna output from said means for summing outputs of each phase shifter, of the beam-forming electronics.

Claim 13 (original): The apparatus of claim 9, wherein the output of the phase shifters constructively amplifies selectively received RF signals by an amplification factor by aligning selective reception lobes of each element of the array of antenna elements, while interference signals from undesired sources are combined by the phase shifters in a random manner, such that the interference signals experience essentially no amplification.

Claim 14 (original): The apparatus of claim 13, wherein the constructive amplification amplifies desired, selectively received RF signals by at least 12 dB.

Claim 15 (original): The apparatus of claim 13, wherein the interference signals have a strength of -30 dB.

Claim 16 (original): The apparatus of claim 1, wherein the navigational controller comprises:

a receiver for receiving RF signal transmissions conveying absolute position information of the apparatus;

an inertial measurement unit (IMU) for measuring changes in relative position of the apparatus; and

a navigation processor connected to the receiver, the IMU, and the beam-forming algorithm processor for receiving absolute and relative position information from the receiver and the IMU, and calculating the pointing vector from the absolute and relative position information, and transmitting the pointing vector to the beam-forming algorithm processor.

Claim 17 (original): The apparatus of claim 16, wherein the receiver comprises a GPS receiver.

Claim 18 (original): The apparatus of claim 17, wherein the GPS receiver contains satellite almanac information comprising location information of satellites.

Claim 19 (original): The apparatus of claim 16, wherein the IMU comprises a vibrational sensor.

Claim 20 (original): The apparatus of claim 16, wherein the IMU comprises a gyroscopic sensor.

Claim 21 (original): The apparatus of claim 20, wherein the gyroscopic sensor comprises a laser gyroscopic sensor.

Claim 22 (original): The apparatus of claim 16, wherein the IMU comprises an accelerometer.

Claim 23 (original): The apparatus of claim 16, wherein the IMU is a micro-machined device.

Claim 24 (original): The apparatus of claim 16, wherein the relative position information comprises a change in velocity.

Claim 25 (original): The apparatus of claim 16, wherein the relative position information comprises a change in angle.

Claim 26 (previously presented): The apparatus of claim 1, wherein the navigation processor is connected to a host.

Claim 27 (original): The apparatus of claim 26, wherein the connection with the host provides input and output (I/O) communications between the navigation processor and the host.

Claim 28 (previously presented): The apparatus of claim 1, wherein the pointing vector is updated using a pre-determined refresh rate.

Claim 29 (original): The apparatus of claim 28, wherein refresh rate is 200 Hz.

Claim 30 (original): The apparatus of claim 28, wherein the refresh rate corresponds to an update rate of the reception lobes.

Claim 31 (currently amended): A method for selectively receiving radio frequency (RF) signals, comprising the steps of:

receiving RF signals using an array of antenna elements including a center antenna and a group of antenna elements surrounding said center antenna;

determining pointing vectors from coordinate information, each pointing vector ~~corresponding~~ pointing to a ~~sources~~ source of one of the received RF signals; and

forming a reception lobe in the direction of each pointing vector, wherein the center antenna is adjusted to a same phase shift for each reception lobe to maintain a phase center for the array of antenna elements.

Claim 32 (currently amended): The method of claim 31, wherein the step of determining a pointing vectors determines a satellite pointing vectors.

Claim 33 (original): The method of claim 31, wherein the step of determining is accomplished using actual coordinate information.

Claim 34 (original): The method of claim 31, wherein the step of determining is accomplished using relative coordinate information.

Claim 35 (original): The method of claim 31, wherein the step of forming the reception lobes is accomplished by shifting the phase of an RF signal received in the step of receiving.

Claim 36 (previously presented): The method of claim 31, further comprising the steps of:

shifting the phase of signals from antenna elements in the array to obtain phase-shifted signals; and

summing the phase-shifted signals obtained in the step of shifting in a manner such that desired RF signals in the direction of each pointing vector are constructively summed, providing an effective amplification of the desired RF signals, while interference RF signals not in the direction of the pointing vectors are not effectively amplified due to random shifting of the interference RF signals.

Claim 37 (currently amended): Apparatus for selectively receiving radio frequency (RF) signals, comprising:

an array of antenna elements for receiving RF signals, said array including a center antenna and a group of antenna elements surrounding the center antenna;

a navigational controller comprising:

an inertial measurement unit (IMU) for measuring changes in relative position of the apparatus; and

a processor for determining pointing vectors based at least in part on coordinate information and the measured changes, wherein each said vector corresponds points to a source of a respective received RF signal; and

beam-forming electronics connected to the array of antenna elements and the navigational controller for forming a reception lobe of the antenna array for each determined pointing vector, wherein a phase center for the array of antenna elements is maintained by adjusting the center antenna to a same phase shift for each lobe.

Claim 38 (previously presented): The apparatus of claim 37, wherein the elements of the array comprise dual-frequency patch elements.

Claim 39 (previously presented): The apparatus of claim 37, wherein the beam-forming electronics form the reception lobes by adjusting the phase of the elements of the array.

Claim 40 (previously presented): The apparatus of claim 37, further comprising an antenna output from the beam-forming electronics.

Claim 41 (previously presented): The apparatus of claim 37, wherein the elements of the array are arranged in a symmetric configuration.

Claim 42 (previously presented): The apparatus of claim 37, wherein the elements of the array are arranged in a radially symmetric configuration.

Claim 43 (previously presented): The apparatus of claim 37, wherein the RF signals comprise signals from at least one global positioning system (GPS) satellite and the pointing vectors comprise a satellite pointing vectors.

Claim 44 (previously presented): The apparatus of claim 37, wherein each reception lobe has a width of 25 degrees or less.

Claim 45 (previously presented): The apparatus of claim 37, wherein said beam-forming electronics comprises:

at least one phase shifter connected to the array of antenna elements for shifting the phase of the received RF signals; and

a beam-forming algorithm processor connected to the at least one phase shifter and the navigational controller for calculating an amount by which the at least one phase shifter shifts the received RF signals in response to the pointing vector.

Claim 46 (previously presented): The apparatus of claim 45, wherein the at least one phase shifter comprises an array of phase shifters.

Claim 47 (previously presented): The apparatus of claim 46, wherein said beam-forming electronics comprises a means for summing outputs of each phase shifter of the array of phase shifters.

Claim 48 (previously presented): The apparatus of claim 47, further comprising an antenna output from said means for summing outputs of each phase shifter, of the beam-forming electronics.

Claim 49 (previously presented): The apparatus of claim 45, wherein the output of the phase shifters constructively amplifies selectively received RF signals by an amplification factor by aligning selective reception lobes of each element of the array of antenna elements, while interference signals from undesired sources are combined by the phase shifters in a random manner, such that the interference signals experience essentially no amplification.

Claim 50 (previously presented): The apparatus of claim 49, wherein the constructive amplification amplifies desired, selectively received RF signals by at least 12 dB.

Claim 51 (previously presented): The apparatus of claim 49, wherein the interference signals have a strength of -30 dB.

Claim 52 (previously presented): The apparatus of claim 37, wherein the navigational controller further comprises a receiver for receiving RF signal transmissions conveying absolute position information of the apparatus,

Claim 53 (previously presented): The apparatus of claim 52, wherein the navigation processor is connected to the receiver and the IMU, determines a pointing vector by way of a calculation based on the actual and relative position information, and transmits the pointing vector to the beam-forming algorithm processor.

Claim 54 (previously presented): The apparatus of claim 52, wherein the receiver comprises a GPS receiver.

Claim 55 (previously presented): The apparatus of claim 54, wherein the GPS receiver contains satellite almanac information comprising location information of satellites.

Claim 56 (previously presented): The apparatus of claim 37, wherein the IMU comprises a vibrational sensor.

Claim 57 (previously presented): The apparatus of claim 37, wherein the IMU comprises a gyroscopic sensor.

Claim 58 (previously presented): The apparatus of claim 57, wherein the gyroscopic sensor comprises a laser gyroscopic sensor.

Claim 59 (previously presented): The apparatus of claim 37, wherein the IMU comprises an accelerometer.

Claim 60 (previously presented): The apparatus of claim 37, wherein the IMU is a micro-machined device.

Claim 61 (previously presented): The apparatus of claim 37, wherein the relative position information comprises a change in velocity.

Claim 62 (previously presented): The apparatus of claim 37, wherein the relative position information comprises a change in angle.

Claim 63 (previously presented): The apparatus of claim 37, wherein the navigation processor is connected to a host.

Claim 64 (previously presented): The apparatus of claim 63, wherein the connection with the host provides input and output (I/O) communications between the navigation processor and the host.

Claim 65 (previously presented): The apparatus of claim 37, wherein the pointing vector is updated using a pre-determined refresh rate.

Claim 66 (previously presented): The apparatus of claim 65, wherein refresh rate is 200 Hz.

Claim 67 (currently amended): A method for selectively receiving radio frequency (RF) signals, comprising the steps of:

receiving the RF signals using an antenna array having a center antenna;
determining actual coordinate information from information conveyed by the RF signals;

sensing at least one change between an inertial reference frame and a reference frame of the antenna;

determining relative coordinate information based on the sensed changes;

determining pointing vectors from the actual and the relative coordinate information, each said pointing vector pointing in the direction of a source one of the RF signals; and

for each pointing vector, forming a reception lobe in a direction ~~based on~~ of the pointing vector, wherein the center antenna is adjusted to a same phase shift for each reception lobe to maintain a phase center for the antenna.

Claim 68 (previously presented): The method of claim 67, wherein the step of determining a pointing vectors determines a satellite pointing vectors.

Claim 69 (previously presented): The method of claim 67, wherein the received RF signals are transmitted from a global positioning system (GPS) satellite.

Claim 70 (previously presented): The method of claim 67, wherein the step of forming the reception lobe is accomplished by shifting the phase of an RF signal received in the step of receiving.

Claim 71 (previously presented): The method of claim 67, wherein a pointing vector is determined for different sources of the received RF signals, and the step of forming a reception lobe includes forming a reception lobe for each of the different RF sources.

Claim 71 (previously presented): The method of claim 71, wherein each of the plurality of RF signals sources corresponds to a different GPS satellite.

Claim 73 (previously presented): The method of claim 67, further comprising the steps of:

shifting the phase of signals from antenna elements in the array to obtain phase-shifted signals; and

summing the phase-shifted signals obtained in the step of shifting in a manner such that desired RF signals in the direction of each pointing vector are constructively summed, providing an effective amplification of the desired RF signals, while interference RF signals not in the direction of the pointing vectors are not effectively amplified due to random shifting of the interference RF signals.